

IN THE SPECIFICATION

Page 1, between the title of the invention and the first line of the text, insert the following:

CROSS-REFERENCE TO RELATED APPLICATION

This Application is a Section 371 National Stage Application of International Application No. PCT/FR2004/001542, filed 18 June 2004 and published as WO 2004/114669 A2 on 29 December 2004, not in English.

FIELD OF THE DISCLOSURE

Please replace the paragraph appearing on page 1, lines 3-6 with the following amended paragraph:

The field of the ~~invention~~ is that of the encoding of sequences of pictures (or images). More specifically, the ~~invention~~disclosure relates to a technique for the encoding of sequences of pictures, by streams of the three-dimensional models, or 3-D models.

Page 1, after line 6, insert the following heading:

BACKGROUND OF THE DISCLOSURE

Page 9, after line 10, insert the following heading:

SUMMARY

Please replace the paragraphs beginning on page 9, line 11 and ending on page 10, line 30 with the following amended paragraphs:

~~The~~An aspect of an embodiment of the invention is aimed especially at overcoming these drawbacks of the prior art.

More specifically, ~~it is a goal of one or more embodiments of~~ the invention ~~to~~ provides a technique for the representation of a sequence of pictures by 3D models that is suited to any type of sequence of fixed or static pictures, or scenes, including complex

ones. In particular, it is the goal of one or more embodiments of the invention to implement a technique of this kind that enables the reconstruction of a scene, on which no assumption is made, that is acquired with an apparatus that is a large-scale consumer product, for which neither the characteristics nor the movement is known.

~~It is another goal of the invention to~~Another aspect of an embodiment of the invention implements a technique of this kind that can be used to obtain a sequence reproduced by reprojection of high visual quality, even when there is a movement away from the original path of the camera used for the acquisition of the sequence.

~~It is yet another goal of the invention to~~Another aspect of an embodiment of the invention provides a technique of this kind that is suited to low and very low bit rates.

~~It is also a goal of the invention to~~Another aspect of an embodiment of the invention implements a technique of this kind that is particularly well suited to large-sized scenes.

~~It is yet another goal of the invention to~~Another aspect of an embodiment of the invention provides a technique of this kind that is suited to applications of encoding and virtual navigation.

~~It is yet another goal of the invention to~~Yet another aspect of an embodiment of the invention implements a technique of this kind that can be used to obtain scalable representations of the sequence of pictures, so as to enable transmission on networks with different bit rates, especially for portable applications.

~~Yet another goal of the invention is to~~Yet another aspect of an embodiment of the invention provides a technique of this kind that can be used, for the same bit rate, to represent scenes of higher visual quality than with Franck Galpin's technique described here above.

~~It is also a goal of the invention to~~Another aspect of an embodiment of the invention implements a technique of this kind that can be used, when representing a sequence of pictures of a same visual quality, to obtain a reduction of the bit rate as compared with the Franck Galpin's technique described here above.

~~These goals, as well as others that shall appear here below are achieved by means of~~For example, one embodiment is directed to a method for representing a sequence of pictures grouped in sets of at least two successive pictures, called GOPs, a textured, meshed 3D model being associated with each of said GOPs.

According to one or more embodiments of the invention, the 3D model associated with the GOP of level n is represented by means of an irregular mesh taking account of at least one vertex of at least the irregular mesh representing the 3D model associated with the GOP of level n-1, said vertex being called common vertex.

Thus, one or more embodiments of the invention ~~rely~~rely on a wholly novel and inventive approach to the representation of a sequence of pictures by 3D models. Indeed, as in the case of the method proposed by Franck Galpin, the invention proposes an approach that relies not on the extraction of a unique 3D model for all the pictures of the sequence but on the extraction of a stream of 3D models, each associated with a group of pictures called a GOP.

Furthermore, an embodiment of the invention proposes an inventive improvement in the Franck Galpin technique by setting up a correspondence between the different 3D models associated with each of the GOPs, in particular so as to increase their redundancy. The ~~invention~~embodiment therefore advantageously enables interactive navigation type applications.

Please replace the paragraphs appearing on page 11, lines 6-14 with the following amended paragraph:

Thus, for equal visual quality, an embodiment of the invention reduces the bit rate of transmission of the sequence of pictures, owing to the redundancy between the different 3D models.

It also makes it possible, for a same bit rate, to obtain better visual quality of the representation of the sequence of pictures, through the tracking of the singularities of the picture between successive 3D models.

According to an advantageous characteristic of an embodiment

of the invention, at least two consecutive 3D models also have, associated with them, a basic model, built from said vertices common to said at least two 3D models.

Please replace the paragraph beginning on page 11, line 24 and ending on page 12, line 2 with the following amended paragraph:

~~—The~~ An embodiment of the invention therefore enables a scalable transmission of the sequence of pictures that can be adapted as a function of the characteristics of the network or of the display terminal. The elements to be transmitted for a reconstruction of the sequence are, in addition to the parameters of the camera, firstly the basic mesh and, secondly, the different wavelet coefficients used to reconstruct the different 3D models. The transmission of a variably large number of wavelet coefficients gives a variably high reconstruction quality adapted to the bit rate at the transmission network or the capacity of the display terminal.

Please replace the paragraph appearing on page 12, lines 23-25 with the following amended paragraph:

According to an advantageous characteristic of an embodiment of the invention, said vertices common to said levels $n-1$ and n are detected by estimation of motion between the first picture of said GOP of level $n-1$ and the first picture of said GOP of level n .

Please replace the paragraphs beginning on page 13, line 17 and ending on page 14, line 24 with the following amended paragraph:

~~The~~ An embodiment of invention also relates to a signal representing a sequence of pictures grouped in sets of at least two successive pictures called GOPs, a textured, meshed 3D model

being associated with each of said GOPs.

According to an embodiment of the invention, such a signal comprises:

- at least one field containing a basic model built from vertices common to at least two irregular meshes, each representing a three-dimensional model, said at least two three-dimensional models being associated with at least two successive GOPs;
- at least one field containing a set of wavelet coefficients used for the construction, by wavelet transformation from said basic model, of at least one three-dimensional model associated with one of said GOPs ;
- at least one field containing at least one texture associated with one of said three-dimensional models;
- at least one field containing at least one camera position parameter.

~~The~~An embodiment of invention also relates to a device for representing a sequence of pictures implementing the representation method described here above.

~~The~~An embodiment of invention also relates to a device for representing a sequence of pictures grouped in sets of at least two successive pictures, called GOPs, a textured, meshed 3D model being associated with each of said GOPs.

According to an embodiment of the invention, such a device comprises:

- means for the building of said three-dimensional models by wavelet transformation of at least one basic model, prepared from vertices common to at least two irregular meshes representing two successive three-dimensional models;
- means for representing said picture of the sequence from said three-dimensional models, from at least one picture of texture, and from at least one camera position parameter.

~~The~~An embodiment of invention also relates to a device for the encoding of a sequence of pictures assembled in sets of at least two successive pictures, called GOPs, a textured, meshed 3D

model being associated with each of said GOPs.

According to an embodiment of the invention, an encoding device of this kind comprises means for the encoding of a three-dimensional model associated with the GOP of level n, said three-dimensional model being represented by means of an irregular mesh taking account of at least one vertex of at least one irregular mesh representing the three-dimensional model associated with the GOP of level n-1.

Other features and advantages of one or more embodiments of the invention shall appear more clearly from the following description of a preferred embodiment, given by way of a simple, non-restrictive example and from the appended drawings, ~~of which:~~.

Page 14, after line 24, insert the following heading:

BRIEF DESCRIPTION OF THE DRAWINGS

Please replace the paragraph appearing on page 15, lines 8-10 with the following amended paragraph:

Figure 5 illustrates the general principle of an embodiment of the present invention, relying on the extraction of a stream of 3D models, each associated with a basic model, common to one or more 3D models;

Please replace the paragraph appearing on page 15, lines 13-14 with the following amended paragraph:

Figure 7 is a block diagram of the different steps implemented according to an embodiment of the invention for the encoding of the pictures of the sequence.

Page 15, after line 14, insert the following heading:

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Please replace the paragraph appearing on page 15, lines 15-18 with the following amended paragraph:

The general principle of an embodiment of the invention is based on the extraction of a stream of 3D models with which irregular meshes are associated, suited to the content of the pictures of the sequence and taking account of the correspondents of the vertices of the irregular mesh of the preceding 3D model.

Please replace the paragraphs beginning on page 15, line 27 and ending on page 16, line 3 with the following amended paragraphs:

By analysis 46 of this original sequence, at least one 3D model 47 is built (a plurality of 3D models according to an embodiment of the invention), from which it is possible to rebuild (48) a sequence of pictures 49, for display on a display terminal.

Referring now to figure 5, we present the general principle of an embodiment of the invention, which is based firstly on a stream of textured, meshed 3D models and, secondly, on the implementation of wavelet transformations.

Please replace the paragraphs appearing on page 16, lines 13-18 with the following amended paragraphs:

~~The invention furthermore relies~~ One or more embodiments of the invention therefore rely on the reconstruction of basic models, that are associated with one or more successive GOPs, as shown in figure 4.

The original sequence of pictures is constituted by successive pictures I_k . Figure 4 more particularly shows the pictures I_0 , I_3 , I_5 , I_{10} , I_{20} , I_{30} , I_{40} , I_{50} , and I_{60} . This sequence may be of any unspecified length, no restrictive hypothesis being necessary in one or more embodiments of the present invention.

Please replace the paragraphs appearing on page 18, lines 1-13 with the following amended paragraphs:

The second set of wavelets r_i^k provides for gradual and efficient (in terms of bit rate) transmission of the different models. Thus the technique of one or more embodiments of the invention can be adapted to all types of terminals, whatever their processing capacity, and to all types of transmission networks, whatever their bit rate.

Referring here below to figure 7, we present the different steps implemented according to an embodiment of the invention, during the encoding of the models and associated textures for representing an original sequence of pictures.

At the input of the algorithm, there is a set of natural pictures I_n to I_m , corresponding to different shots taken of a scene or of an object of the real world, as illustrated here above with reference to figure 4. In a preferred embodiment of the invention, the pictures are in the ppm format and in the pgm format. TheOne or more embodiments of the invention can of course be applied also to any other picture format.

Please replace the paragraph appearing on page 22, lines 6-10 with the following amended paragraph:

T depends on the type of wavelets used. Three schemes are given preference in an embodiment of the invention: piecewise affine wavelets, polynomial wavelets (especially Loop wavelets) and wavelets based on the Butterfly subdivision scheme (J. Warren and al., "Multiresolution Analysis for Surfaces of Arbitrary Topological Type," *ACM Transactions on Graphics*, vol. 16, pp. 34-73, 1997).

Please replace the paragraphs appearing on page 24, lines 13-22 with the following amended paragraphs:

TheOne or more embodiments of the invention therefore ~~enables~~enable the transmission of the geometry of the models associated with the original sequence at low cost since, on the

one hand, the basic meshes and, on the other hand, the wavelet coefficients associated with the different models are transmitted.

The applications that can be envisaged in the context of embodiments of the invention are numerous. ~~The~~An embodiment of the invention can also be applied especially to the encoding of pictures representing a same fixed scene (which may be a set of independent pictures or a video sequence). The compression rates achieved by this type of representation are situated in the low and very low bit rates (typically in the range of 20 kbits/s) and it is therefore possible to envisage portable applications.

Please add the following paragraph on page 24, after line 25:

Although the present invention has been described with reference to one or more embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.